NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

PLANT GROWTH REGULATORS: AN ALTERNATIVE TO FREQUENT MOWING

by

Robert Jean Johnson

June 1990

Thesis Advisor: Paul M. Carrick

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School	6b OFFICE SYMBOL (If applicable) Code 36
7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School	
6c ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000	7b ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION	8b OFFICE SYMBOL (If applicable)
9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c ADDRESS (City, State, and ZIP Code)	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
PLANT GROWTH REGULATORS: AN ALTERNATIVE TO FREQUENT MOWING

12 PERSONAL AUTHOR(S)
Johnson, Robert J.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Master's Thesis	FROM ____ TO ____	1990, June	47

16 SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Plant Growth Regulators; Growth Inhibitors

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

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The highest potential savings are in areas where the frequency of mowing is weekly or biweekly. In areas where the mowing frequency is one time per month, the savings approach a breakeven.

The results indicate considerable cost savings can be realized at both naval air stations if a well-planned PGR application program is implemented.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Prof. Paul M. Carrick	22b TELEPHONE (Include Area Code) (408) 646-2939 / 22c OFFICE SYMBOL Code AS/Ca

DD Form 1473, JUN 86 Previous editions are obsolete

S/N 0102-LF-014-6603

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

Approved for public release; distribution is unlimited

Plant Growth Regulators: An Alternative
to Frequent Mowing

by

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Submitted in partial fulfillment of the
requirements for the degree of

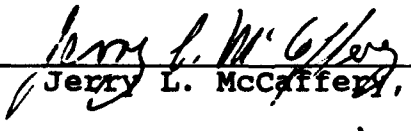
MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1990

Author: 
Robert J. Johnson

Approved by: 
Paul M. Carrick, Thesis Advisor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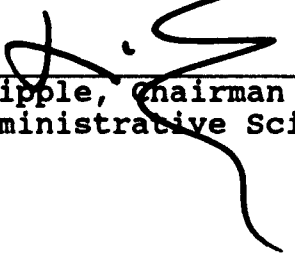
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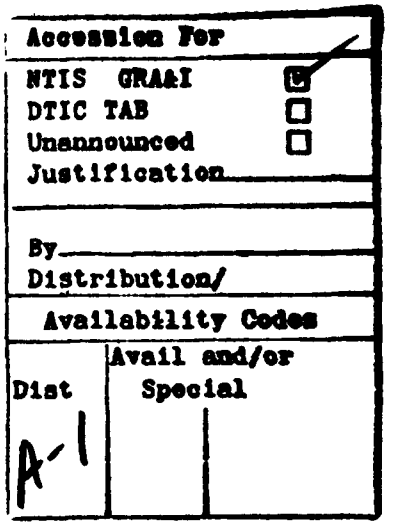
ABSTRACT

The focus of this thesis is to determine if the application of Plant Growth Regulators (PGR's) to frequently mowed semi-improved areas can minimize the total annual mowing costs at Naval Air Station Cecil Field, Florida and Naval Air Station Jacksonville, Florida.

The highest potential savings are in areas where the frequency of mowing is weekly or biweekly. In areas where the mowing frequency is one time per month, the savings approach a breakeven.

The results indicate considerable cost savings can be realized at both naval air stations if a well-planned PGR application program is implemented.



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I. INTRODUCTION

A. BACKGROUND

Grounds maintenance requirements at U.S. Naval activities are time consuming and expensive. Mechanical mowing of grasses consumes a sizeable portion of a typical activity's grounds maintenance budget. Expenditures in this area within DoD are estimated to exceed $200 million annually [Ref. 1]. Alternatives to mowing grasses exist and have been found in many instances to be cost effective. One of the alternatives being used by both the private sector and various local, state and federal agencies is the application of plant growth regulators (PGR's) to various grasses and shrubs.

B. RESEARCH OBJECTIVE

The objective of this thesis is to analyze the cost effectiveness of using a plant growth regulator (PGR) to minimize an activity's annual grounds maintenance costs. The intention of this is twofold:

- A facility manager will be able to use the analytical results of this thesis to determine his or her best action.
- A facility manager will be able to apply the methodology used in this thesis to perform a cost/ benefit study.

C. RESEARCH QUESTION

The primary research question is: Will the application of a plant growth regulator (PGR) result in a sufficiently large reduction in an activity's total annual grass cutting costs? Subsidiary research questions are as follows:

- Which mowed areas at an activity should be considered for the application of PGR's?
- Should PGR's be applied throughout the growing season?
- Does the Naval Facilities Engineering Command (NAVFAC) recommend the use of PGR's to its field activities?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

This thesis focuses on the results of PGR research and applies those results to cost/benefit analyses of two typical naval activities. Bahiagrass is the common warm season grass at the two activities. The variety of grasses found at other Naval activities will vary, depending on geographic location and climate. The recommended PGR to be applied and its effectiveness will also vary depending on the activity's location. Therefore, it is essential that a PGR application program be tailored to a specific activity by professionals with knowledge of the local turf grasses and PGR's.

There are variances documented in the PGR research data from one year to the next [Ref. 1]. The facility manager should consider these variances and consult with his

forester, or resident expert, on PGR's before making a decision on their use.

The field of knowledge relating to PGR's is growing each year. Reliance on several expert sources for information is recommended before the decision is made regarding an annual PGR application program.

E. LITERATURE REVIEW AND METHODOLOGY

Information for this thesis was obtained primarily through a detailed literature review. A secondary source of information was field research.

1. Literature Review

A thorough review of existing research data on PGR's was performed. Included in this review were periodicals, professional journals, conference papers, manufacturers' fact sheets and research data collected by the U.S. Army Corps of Engineers.

Information on PGR's included data compiled from basic field research. This data showed the results from applying different types of PGR's at different concentrations on various grasses. Other information included articles from PGR users and addressed the effectiveness of PGR's. These users included state highway departments, county agencies, airport authorities, private landscapers, and golf course maintenance professionals.

2. Field Research

Field research included telephone interviews with research personnel and present and potential users of PGR's. These interviews were used to clarify and confirm information as well as obtain any new information on the subject.

F. ORGANIZATION OF STUDY

Chapter II discusses the background on PGR's and identifies factors which are critical to establishing an effective PGR application program. Chapter III details the cost/benefit study performed at two Naval activities in the Southeast United States. Chapter IV provides conclusions and recommendations based on this study.

II. BACKGROUND OF PLANT GROWTH REGULATORS

In the late 1940's the U.S. Rubber Company developed a synthetic PGR for use on trees, shrubs and turf. This PGR was maleic hydrazide (MH). Its effectiveness was varied and led to the development of other PGR's in the years to follow. Today's products are much improved, providing more consistent results in controlling the growth of vegetation. [Ref. 2] Chemicals used as PGR's include sulfometuron methyl methyl2, glyphosphate, maleic hydrazide, and amidochlor. Manufacturers such as Dupont, 3M, Monsanto, and Uniroyal market these chemicals under various trade names. Some of the problems which exist today with PGR's include:

- discoloration (yellowing) of turf after application.
- thinning of turf.
- poor wear tolerance.
- decreased disease tolerance.
- different effects on turf with mixed stands of foliage.

A. CATEGORIES OF PGR'S

Plant growth regulators fall into two basic categories. Foliarly-absorbed compounds are taken in through the foliage. To be effective these PGR's must remain in contact with the leaf for several hours. The second type is the root/crown-absorbed PGR. Regulators of this type must be

taken in through the crown or root system in order to be effective. Adequate rainfall or an irrigation system is necessary for the root system to properly absorb this type of PGR. [Ref. 2]

B. DESIRED TRAITS IN A PGR

The ideal PGR has not been developed but if it existed it would have the following traits: [Ref. 3]

- Reasonably long residual activity.
- Inhibition of seedhead and stalk formation.
- No objectionable discoloration or chemical burning of the turf.
- Control or suppression of broadleaf leaves.
- No reduction in turfgrass quality with repeated usage.
- Low toxicity to desireable vegetation and no long-term residual.

C. CATEGORIES OF TURF

There are three turf classifications which are currently maintained by mechanical mowing. These include fine turf, medium turf and rough turf. Fine turfs include home lawns, lawns around office buildings and golf course fairways. Medium turfs include school grounds, athletic fields and cemeteries. Since the application of PGR's leads to poor turf color (yellowing) and other unpredictable effects it is not widely used on fine and medium turfs. Rough turfs include airport clear areas, highway medians, road ditches, some industrial grounds, ammunition storage areas and golf

course roughs. The approximate frequency of mechanical mowing of the different turf classifications will be 12 or more per year for fine turf, six to 11 times per year for medium turf and up to five times per year for rough turf. [Ref. 2]

D. USE OF PGR'S OUTSIDE DOD

The use of PGR's in the public and private sector is widespread. In 1986, 38 states responded to a survey which targeted the use of PGR's as part of their mowing maintenance program. Several states indicated that PGR's played an active role in their program. Other states were dissatisfied with PGR's and used them only experimentally or in a very limited active program. [Ref. 9]

Areas in the private sector which have shown promise from a PGR program include cemetery, golf course and roadside maintenance. Several landscaping firms are also testing PGR's as a cost-saving alternative to frequent pruning of ornamental shrubs and ground cover.

The trend in the public and private sector is for increased use of PGR's. Cost savings through reduced maintenance is cited as the principle reason for using PGR's.

E. TIMING OF APPLICATION

The correct timing of the application of a PGR is crucial to achieving its desired goal. The time of

application will vary each year depending on the morphological stage of plant development. This stage of plant growth will be determined by the recent weather conditions and other factors. A factor which makes the timing of application more difficult is the existence of a mixed turf (polystand). Generally it is recommended that a PGR be applied before the first seedhead emerges. [Ref. 2]

F. FACTORS AFFECTING PGR EFFICACY

A plant's absorption of a PGR will vary. If a PGR is to be foliarly absorbed and the PGR is washed off before sufficient time has elapsed, then its effect may be diminished. The amount of time required for the chemical to be in contact will vary from plant to plant as well as from chemical to chemical.

The efficacy of crown- and/or root-absorbed compounds might be diminished by either too much moisture or too little. Too little moisture would prevent the PGR from being carried to the uptake point in the plant and too much would wash it away.

Climatic factors will also influence PGR uptake by plants. It has been found that a plant will react to its surroundings. This might lead to diminished efficiency in its absorption of the PGR. Evidence of the existence of these climatic factors is supported by studies which show

varying effects of PGR's from one year to the next. [Ref. 2]

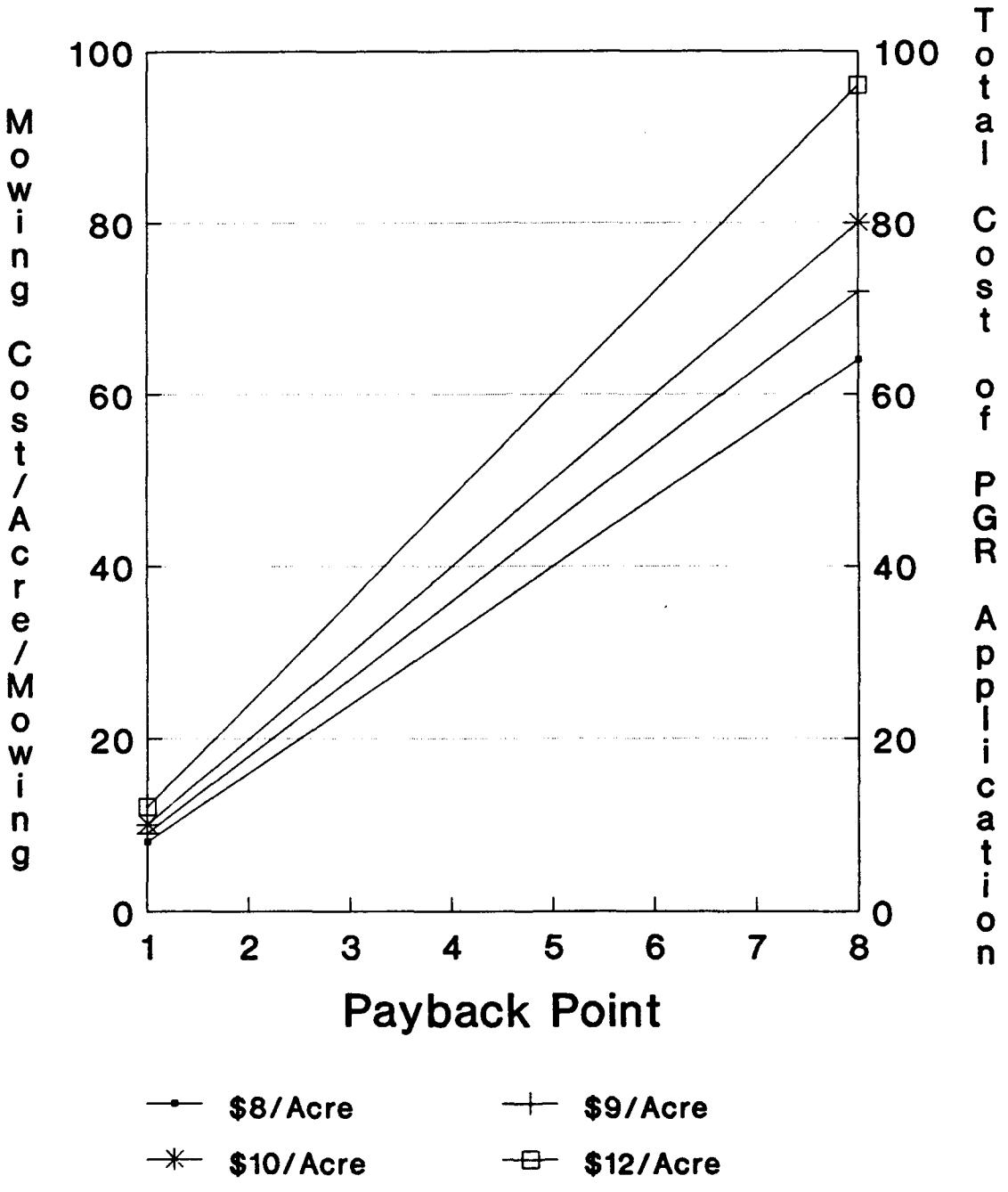
G. ECONOMIC BENEFITS FROM PGR'S

The benefits to be realized by an activity using PGR's will vary depending on the pre-PGR frequency of mechanical mowing, cost/acre of maintaining those areas and the cost of PGR application. Possible savings can be found in the areas of fuel, insurance, labor, and equipment maintenance costs. Another factor to consider is that some areas which are maintained by mechanical mowing are subject to erosion. The more frequently these areas are cut, the higher are the costs to repair erosion damage.

A breakeven point for using PGR's will vary depending on a number of factors and input prices but a professionally-acceptable rule of thumb is that the use of a PGR must replace three mowings before it begins to payoff. Chart 1 can be used to estimate the number of mowings which must be eliminated (payback point) before the application of a PGR is cost effective. For example, if an activities mowing cost is $12 per acre and its estimated cost of PGR application is $20 per acre do the following to find a payback point:

- Locate the upward sloping line which corresponds to a $12 per acre mowing cost.
- Locate the point which corresponds to a total PGR application cost of $20 per acre.

Chart 1


Mowing Cost/Acre/Mowing
Total Cost of PGR Application
100
80
60
40
20
0
1
2
3
4
5
6
7
8
Payback Point
$8/Acre
$9/Acre
$10/Acre
$12/Acre

- Extend a horizontal line from the total PGR application cost to a point of intersection with the selected upward sloping line.
- Drop a vertical line from the point of intersection to determine the payback point.

Based on the analysis of this data, the payback point for applying a PGR is approximately two mowings. If the PGR applied cannot save at least two mowings then its application would not be cost effective.

H. NAVAL ACTIVITY USE OF PLANT GROWTH REGULATORS

At the present time the use of PGR's by Naval activities is minimal. The U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi is nearing completion on a three year study to determine the effectiveness of PGR's on grasses at two Naval activities. The activities are Naval Air Station Willow Grove, Pennsylvania and Naval Weapons Station Charleston, South Carolina.

Positive results from this study may lead to more interest on the part of the Navy in using PGR's. At this time the Naval Facilities Engineering Command (NAVFAC) has no policy on the use of PGR's. However, the Program Manager for Facility Support Contracts and Commercial Activities at NAVFAC is interested in the possibility of including an option to use PGR's in future grounds maintenance contract specifications.

III. COST/BENEFIT ANALYSIS

A. NAVAL ACTIVITIES STUDIED

Originally, Naval Air Station Cecil Field, Florida and Naval Weapons Station Crane, Indiana were the activities selected for study. However, when information on the Naval Weapons Station's mowing frequency and cost data were received, consideration of their inclusion in the study was rejected. Based on the nominal, one to three time per year mowing frequency required in different areas, the possibility of reducing the expenditure of grounds maintenance dollars through the use of a PGR was very unlikely [Ref. 4]. Studies have shown the frequency of cutting must typically be once a month or more to make the application of a PGR cost effective.

Due to the rejection of NWS Crane, Indiana as a study candidate, mowing frequency data were obtained from Naval Air Station Jacksonville, Florida [Ref. 5]. NAS Jacksonville and NAS Cecil Field have very similar mowing requirements. The majority of their mowing is in semi-improved areas along runways, roadside right-of-ways and various other areas which do not have fine turf grasses. These candidate areas have mowing requirements of one time per month or greater for five to seven months per year.

B. BASIS OF COST ESTIMATE

NAS Cecil Field's cost estimate was prepared using Engineered Performance Standards (EPS) [Ref. 6]. These standards consider a multitude of factors in the time estimation process. Items such as size of equipment used, location and size of area to be mowed, distance to the job site, and personal time factors are included in the estimation process.

NAS Cecil Field's semi-improved areas (Table 3) were broken into 48 different areas. The number of areas (48) was determined by the number of hours it takes to mow different locations at the activity. The number of hours for each location was determined using EPS. Those areas scheduled for mowing one time per month or more during the period April through October or May through September were selected for the study. Those areas scheduled for less than monthly mowing or those areas scheduled for mowing during the cooler winter months were not considered for the same reason as NWS Crane, Indiana.

NAS Jacksonville's estimate was not prepared in accordance with EPS. A review of a recent NAS Jacksonville mowing contractor's prices indicated the likelihood of a possible imbalance in the submitted schedule of deductions [Ref. 7]. The average mowing price shown for 200 acres of Improved Grounds Care was $6.10 per acre. The price shown for 670 acres of Semi-Improved Grounds Care was $4.22 per

acre. Prices for both areas were well below the average EPS based price at NAS Cecil Field which was $9.78 per acre. Conversation with Public Works personnel at NAS Jacksonville confirmed that these prices were in fact not realistic.

Since NAS Jacksonville and NAS Cecil Field are very similar in their grass-cutting requirements, an average price for NAS Cecil Field's mowing requirements was used as the per acre mowing cost for NAS Jacksonville. The average price of $9.78 per acre was determined to be reasonable by the Facility Support Contracts personnel at NAS Jacksonville and Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) in Charleston, South Carolina. Based on both activity's concurrence, $9.78 per acre is used as the estimated mowing cost for the study areas at NAS Jacksonville.

The estimated mowing costs per acre at both activities are simple annual costs. They are not based on a net present value (NPV) calculation for more than one year.

C. BASIS FOR UNIT COST OF MOWING

The total average unit cost of mowing per acre includes material, equipment, depreciation and maintenance, labor and contractor overhead and profit. These are the direct costs the government will pay the contractor for mowing performance.

Other costs which the government incurs for the mowing maintenance contracts at the two activities are indirect costs. The costs include expenses for contract preparation, advertisement, award and contract administration. Generally the total costs of these contract support functions are divided among a large number of contracts at both the activity and at the Engineering Field Division (EFD) level. It is not the intent of this study to determine these specific costs and apply them to the unit cost for mowing at each activity.

D. BASIS FOR COST OF PGR APPLICATION

A three-year U.S. Army Engineers Waterways Experiment Study performed at Charleston Naval Weapons Station considered the effects of a PGR program on mowing maintenance costs. This study was used as the basis for the cost/benefit study at NAS Jacksonville and NAS Cecil Field because of the similarities in vegetation and climate.

The three year study (1987, 1988, 1989) showed that the following regimen resulted in effective control of bahiagrass for an average period of ten weeks after application in the Spring [Ref. 8]:

- Mowing the target area (pretreatment mowing) prior to PGR application.
- Application of the Dupont chemical, Oust, at the rate of .5 ounces per acre. (Oust was mixed with the volume of water recommended by the chemical manufacturer.;

The cost of the PGR ($10/ounce) was obtained from a Dupont representative. The cost of applying the PGR ($5/acre) was an estimate used in the Corps of Engineers study [Ref. 1].

E. SAMPLE CALCULATIONS FOR MOWING COSTS

Sample Location: NAS Cecil Field

Area for PGR Use: #1

Total Acres: 10

1. Calculation of Grass Cutting Costs W/O PGR Application

   Mowing Frequency: 2x/Month (Table 3)

   Mowing Cost/Acre: $8.36 (Table 3)

   Time Period Covered: May through September (Table 3)

   Total Mowing Costs for 5 Months:

   Mowing Frequency x Time Period Covered x Mowing Cost/Acre x Total Acres = Total Cost

   2 x 5 x $8.36 x 10 = $836

2. Calculation of Grass Cutting Costs W/PGR Application

   Mowing Frequency: 2x/Month (Table 3)

   Mowing Cost/Acre: $8.36 (Table 3)

   Time Period Covered: May through September (Table 3)

   PGR Chemical: Oust (Dupont Chemical)

   Recommended Rate of Application: .5 Ounce/Acre

   Cost of PGR: $10/Ounce

Cost of Pretreatment Mowing: $8.36/Acre

Cost of PGR Application: $5/Acre

Average Duration of PGR Effectiveness: 10 Weeks

Additional Mowings Required for Area Based on 10 Week

Effective Period: 5

Total Mowing Costs for 5 Months:

(Cost/Acre for Pretreatment Mowing + Cost/Acre for PGR + Cost/Acre for PGR Application) x Total Acres + (Mowing Cost/Acre x Total Acres x Additional Mowings Required After PGR Loses Effectiveness) = Total Mowing Cost

($8.36 + $5 + $5) x 10 + ($8.36 x 10 x 5) = $602

(Rounded to Nearest Whole Dollar)

Total Savings Using PGR:

Total Mowing Costs W/O PGR - Total Mowing Costs W/PGR = Total Cost Savings

$836 - $602 = $234

% Savings Using PGR:

Total Savings Using PGR/Total Mowing Costs W/O PGR = % Savings

$234/$836 = 28% (Rounded to Nearest Whole Percent)

F. SUMMARY OF PGR EFFECTIVENESS AT NAS CECIL FIELD

An analysis of the costs of current mowing practices versus the predicted costs using a PGR shows significant

savings can be realized if a PGR application program is implemented.

The total cost of current mowing practices in the areas studied is $107,390 per year. The cost of mowing the same areas when using a PGR would be $92,038. The $15,352 (14%) savings is significant (Table 5).

The estimated percent savings using a PGR application program range from a high of 32% in an area when the frequency of mowing is two times per month and at a cost of $12.36 per acre to a low of -2% (loss) when the frequency of cutting is one time per month at a cost of $8.91 per acre (Table 3).

The average savings using a PGR application program in areas cut more frequently than one time per month is nearly 29%. The average savings on PGR treated areas where the frequency of cutting is one time per month is less than 1%.

G. SUMMARY OF PGR EFFECTIVENESS AT NAS JACKSONVILLE

The analysis of NAS Jacksonville's mowing costs is somewhat easier than an analysis of NAS Cecil Field's primarily because NAS Jacksonville has two principle mowing areas to study versus the 48 at Cecil Field. Level I (Improved Grounds Care) totals 200 acres and is to be mowed once per week during the period March through October. Level II (Semi-Improved Grounds Care) totals 670 acres and

is to be mowed two times per month during the period March through October.

Since NAS Jacksonville had not prepared an independent government estimate based on Engineered Performance Standards (EPS), an average mowing cost per acre of similar areas at NAS Cecil Field (Table 3) is used for analysis purposes. If NAS Jacksonville implements a PGR application program in the future, a detailed estimate of the different mowing areas should be performed using EPS. This will identify the locations, based on a per acre cost, where a cost savings can be realized by applying a PGR. The $9.78 per acre mowing cost is considered acceptable by both NAS Jacksonville and Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) facility support contract personnel.

An analysis of the current mowing practices at NAS Jacksonville versus the predicted costs using a PGR (Table 4) show significant savings can be realized if a PGR application program were implemented.

The total costs of current mowing practices in the areas studied is $167,434 per year. The cost of mowing the same areas is predicted to be $132,319 when utilizing a PGR application program. The $35,115 (21%) savings is significant. The percent savings using a PGR range from a high of 24.9% when mowing four times per month to 18.6% when mowing two times per month (Table 4).

H. SUMMARY OF RESULTS

The cost/benefit study shows that both NAS Cecil Field and NAS Jacksonville can benefit from a PGR application program. Based on the use of the PGR, Oust, a ten week effective period after application, and the estimated per acre mowing costs, NAS Cecil Field and NAS Jacksonville could realize a mowing maintenance cost reduction of $15,352 (14%) and $35,115 (21%) respectively (Table 5).

It is important to realize the actual savings will vary depending on the actual effective period of the PGR, the actual cost of PGR application and the actual mowing costs per acre.

IV. CONCLUSIONS AND RECOMMENDATIONS

The intent of this thesis was to determine, based on cost estimates and mowing requirements, whether the application of a PGR could theoretically save two Naval activities grounds' maintenance dollars.

The results indicate considerable cost savings can be realized at both Naval Air Station Cecil Field and Naval Air Station Jacksonville if a well-planned PGR application program is implemented. This program must consider the present mowing costs, frequency of mowing, cost of PGR application and the effectiveness of the PGR applied.

The highest potential savings are in areas where the frequency of mowing is weekly or biweekly. In areas where the mowing frequency is one time per month, the savings approach a breakeven point. However, a PGR program can be beneficial in the less-frequently mowed areas (one time per month) if the frequency of mowing creates erosion problems or the areas are dangerous to mow. An analysis on erosion and safety-related problems was not considered in this theses.

The timing of PGR application, proper turf preparation (premowing), and weather conditions are crucial to the effectiveness of a PGR. The application of the right

chemical at the wrong time on improperly prepared turf can eliminate the possibility of any cost savings. [Ref. 2]

All Naval activities which mow a significant amount of semi-improved acreage should consider using PGR's. This PGR program should be developed and monitored by individuals who have knowledge of turf grasses and PGR's peculiar to their geographic location. Assistance can be provided by a number of sources which include NAVFAC's Engineering Field Divisions, the U.S. Army Engineers Waterways Experiment Station Environmental Laboratory in Vicksburg, Mississippi or knowledgeable experts in the private sector.

APPENDIX

TABLES

TABLE 1

SUMMARY OF MOWING ACTIVITIES AT NAVAL AIR STATION CECIL FIELD, FLORIDA

Mowing Category	Site Description	No. of Acres	Mowing Frequency	Cost of Mowing/Acre
Area #1	Main Station-perimeter road	10	2x/Month:May-Sept	$8.36
Area #1	Main Station-perimeter road	10	1x each period: 10 Oct-20 Oct 25 Nov-5 Dec 25 Jan-5 Mar 25 Mar-5 Apr	$8.36
Area #2	Main Station-ordnance svce roads	47	Same as Area #1	$9.19
Area #3	Main Station-all designated roads	41	4x Annually: Apr,Jun,Aug,Oct	$9.18
Area #4	Main Station-perimeter fence	13.6	2x Annually: May,Sept	$8.20
Area #4A	Main Station-perimeter fence	5.25	Same as Area #1	$11.68
Area #5	Main Station-magazine slopes	6.5	1x/Month:Apr-Oct	$34.31
Area #5	Main Station-magazine slopes	6.5	1x during period: 1 Jan-10 Jan	$34.31
Area #6	Main Station-magazine clear-ance areas	22	Same as Area #1	$10.14

TABLE 1 (CONTINUED)

Mowing Category	Site Description	No. of Acres	Mowing Frequency	Cost of Mowing/Acre
Area #7	Main Station-Bldgs. 193, 401, 500, 502, 504	9	Same as Area #1	$12.39
Area #8	Main Station-antenna, IVR and ceilometer sites	3.5	Same as Area #5	$11.55
Area #9	Main Station-airfield-runways taxiways and aprons	63	Same as Area #1	$9.07
Area #10	Main Station-semi-improved airfield grounds	745	1x/Month Apr-Oct	$8.91
Area #10	Main Station-semi-improved airfield grounds	745	1x During period: 1 Jan-10 Jan	$8.91
Area #11	Main Station-airfield un-improved run-way clearance zone	350	1x During month of November	$8.92
Area #12	Outlying Field perimeter road	12	2x Annually: May,Sept	$9.29
Area #13	Outlying Field roads and paved areas	6.5	4x Annually: Apr, Jun, Aug, Oct	$9.65
Area #14	Outlying Field runway	7.5	Same as area #1	$8.18
Area #15	Outlying Field airfield semi-improved grounds	36.8	Same as area #10	$9.09
Area #16	Outlying Field designated areas	285	1x During month of November	$8.95

TABLE 1 (CONTINUED)

Mowing Category	Site Description	No. of Acres	Mowing Frequency	Cost of Mowing/Acre
Area #17	power distribution lines	14	1x During month of June	$7.97
Area #18	power sub-station	1	2x Annually: May, Sept	$13.94
Area #19	Main Gate Weapons Area	5	4x/Month: Apr-Oct	$8.09
Area #19	Main Gate	5	1x/Month: Nov-Mar	$8.09
Area #20	flight line fence	2	2x Annually: April, October	$10.46
Area #21	Building 288	2	Same as area #1	$7.97
Area #22	Building 829 ditches	2.5	1x/Month: Apr-Sept	$10.22
Area #23	Weapons Area outer compound	32.5	2x Annually: October, April	$9.01
Area #24	Weapons Area EOD Burnsite	10.5	2x Annually: October, April	$10.62
Area #25	Weapons Area bike path	10	4x Annually: Apr, Jun, Aug, Oct	$8.36
Area #26	Weapons Area Clean Zone	8	Same as Area #19	$7.70
Area #27	Weapons Area Helo Pad Rd.	3	4x Annually: Oct, Jan, Apr, Jul	$9.29
Area #28	Weapons Area magazines	19	4x Annually: Apr, Jun, Aug, Oct	$9.17
Area #29	Weapons Area Rail Head Rd	8	4x Annually: Apr, Jun, Aug, Oct	$7.84
Area #30	Weapons Area unpaved roads	30	1x During month of July	$8.83
Area #31	Main Station-Officer's Pool	8.5	Same as Area #19	$9.84

TABLE 1 (CONTINUED)

Mowing Category	Site Description	No. of Acres	Mowing Frequency	Cost of Mowing/Acre
Area #32	Main Station-D Ave. picnic area	16	Same as Area #19	$8.71
Area #33	Main Station-6th St. and J Ave.	21	Same as Area #19	$8.30
Area #34	A and D Ave. from 9th St. to gates	24	Same as Area #19	$9.29
Area #35	Main Station Building 15	10	Same as Area #19	$8.36
Area #36	Weapons Area admin buildings	30	Same as Area #19	$8.83
Area #37	Main Station-Fuel Farms	10	Same as Area #19	$8.36
Area #38	Main Station-10th St. from A Ave. east to fence and D Ave. east to fence	1.1	Same as Area #19	$13.94
Area #39	Main Station-Jet Rd. from 10th St. to Building 330	1	Same as Area #19	$15.33
Area #40	Weapons Compound	3	4x/Month:Apr-Oct	$8.36
Area #40	Weapons Compound	3	2x/Month:Nov-Mar	$8.36
Area #41	Main Station-Missile Shop	2	Same as Area #1	$7.67
Area #42	Correctional Custody Facility	4	Same as Area #19	$10.11
Area #43	Not used			

TABLE 1 (CONTINUED)

Mowing Category	Site Description	No. of Acres	Mowing Frequency	Cost of Mowing/Acre
Area #44	Main Station-CPO Club	11.25	Same as Area #19	$9.91
Area #45	Main Station-Lake Fretwell	4	Same as Area #19	$10.11
Area #46	Main Station-Lake Newman	3	Same as Area #19	$8.36
Area #47	Weapons Area "Rabbit Run"	1.25	Same as Area #40	$12.27
Area #48	Weapons Area Youth Center	.75	Same as Area #19	$20.45

TABLE 2

SUMMARY OF MOWING ACTIVITIES AT NAVAL AIR STATION JACKSONVILLE, FLORIDA

Mowing Category	Site Description	No. of Acres	Mowing Frequency	Cost of Mowing/Acre
Level I	Various areas NAS	200	4x/Month Mar-Oct	*$9.78
Level II	Various areas	670	2x/Month Mar-Oct	*$9.78

* The mowing cost/acre for Naval Air Station Jacksonville, Florida is based on the average cost/acre for mowing similar areas at Naval Air Station Cecil Field, Florida. Cecil Field's costs were estimated using NAVFAC P-712.0, Engineered Performance Standards for Roads, Grounds, Pest Control and Refuse Collection Handbook.

TABLE 3

EXPECTED MOWING AND PGR TREATMENT COSTS FOR VARIOUS SELECTED AREAS AT NAVAL AIR STATION CECIL FIELD, FLORIDA FOR PERIODS INDICATED

Mowing Frequency	2x/Month May-Sept	2x/Month May-Sept	2x/Month May-Sept	2x/Month May-Sept
Area #	1	2	4A	6
Acres	10	47	5.25	22
Mowing Cost/Acre	$8.36	$9.19	$11.68	$10.14
Total Mowing Cost W/O PGR	$836	$4319	$613	$2231
Total Mowing Cost W/PGR*	$602	$3062	$420	$1558
Savings ($)	234	1257	193	673
% Savings	28	29	31	30

* Total mowing cost W/PGR, for the purpose of this study, includes one initial mowing prior to application of PGR, PGR application cost, cost of PGR, and any additional mowings required following effective period of PGR. The effective period of the selected PGR is ten weeks. This period is based on a three year study at Charleston Naval Weapons Station performed by Linda S. Nelson with U.S. Army Engineer Waterways Experiment Station Vicksburg, Mississippi.

TABLE 3 (CONTINUED)

Mowing Frequency	2x/Month May-Sept	2x/Month May-Sept	2x/Month May-Sept	2x/Month May-Sept
Area #	7	9	14	21
Acres	9	63	7.5	2
Cost/Acre	$12.39	$9.07	$8.18	$7.97
Total Mowing Cost W/O PGR	$1115	$5714	$614	$159
Total Mowing Cost W/PGR	$759	$4058	$443	$116
Savings ($)	356	1656	171	43
% Savings	32	29	28	27

TABLE 3 (CONTINUED)

Mowing Frequency	2x/Month May-Sept	*1x/Month Apr-Oct	1x/Month Apr-Oct	1x/Month Apr-Oct
Area #	41	**5	8	10
Acres	2	6.5	3.5	745
Cost/Acre	$7.67	$34.31	$11.55	$8.91
Total Mowing Cost W/O PGR	$153	$1562	$283	$46,466
Total Mowing Cost W/PGR	$112	$1501	$276	$47,278
Savings ($)	41	61	7	<812>
% Savings	27	4	2	<2>

* When calculating total mowing costs W/PGR application in areas receiving 1x/month mowing Apr-Oct, five additional cuttings beyond effective period of PGR were used.

** Area #5 is a magazine slope area. Cost of application is estimated at $20/acre + precutting and chemical costs.

TABLE 3 (CONTINUED)

Mowing Frequency	1x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct
Area #	15	19	26	31
Acres	36.8	5	8	8.5
Cost/Acre	$9.09	$8.09	$7.70	$9.84
Total Mowing Cost W/O PGR	$2342	$1133	$1725	$2342
Total Mowing Cost W/PGR	$2375	$819	$1250	$1674
Savings ($)	<33>	314	475	668
% Savings	<1>	28	27	29

TABLE 3 (CONTINUED)

Mowing Frequency	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct
Area #	32	33	34	35
Acres	16	21	24	10
Cost/Acre	$8.71	$8.30	$9.29	$8.36
Total Mowing Cost W/O PGR	$3902	$4880	$6243	$2341
Total Mowing Cost W/PGR	$2808	$3522	$4476	$1688
Savings ($)	1094	1358	1767	653
% Savings	28	28	28	28

TABLE 3 (CONTINUED)

Mowing Frequency	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct
Area #	36	37	38	39
Acres	30	10	1.1	1
Cost/Acre	$8.83	$8.36	$13.94	$15.33
Total Mowing Cost W/O PGR	$7417	$2341	$429	$429
Total Mowing Cost W/PGR	$5333	$1688	$302	$301
Savings ($)	2084	653	127	128
% Savings	28	28	30	30

TABLE 3 (CONTINUED)

Mowing Frequency	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct
Area #	40	42	44	45
Acres	3	4	11.25	4
Cost/Acre	$8.36	$10.11	$9.91	$10.11
Total Mowing Cost W/O PGR	$702	$1132	$3122	$1132
Total Mowing Cost W/PGR	$507	$808	$2231	$808
Savings ($)	195	324	891	324
% Savings	28	29	29	29

TABLE 3 (CONTINUED)

Mowing Frequency	4x/Month Apr-Oct	4x/Month Apr-Oct	4x/Month Apr-Oct	1x/Month Apr-Sept
Area #	46	47	48	22
Acres	3	1.25	.75	2.5
Cost/Acre	$8.36	$12.27	$20.45	$10.22
Total Mowing Cost W/O PGR	$702	$429	$429	$153
Total Mowing Cost W/PGR	$507	$304	$299	$153
Savings ($)	195	125	130	0
% Savings	28	29	30	0

TABLE 4

EXPECTED MOWING AND PGR TREATMENT COSTS FOR VARIOUS SELECTED AREAS AT NAVAL AIR STATION JACKSONVILLE, FLORIDA FOR PERIODS INDICATED

Mowing Frequency	4x/Month Mar-Oct	2x/Month Mar-Oct
Area #	Various Areas NAS	Various Areas NAS
Acres	200	670
Cost/Acre	$9.78	$9.78
Total Mowing Cost W/O PGR	$62,592	$104,842
Total Mowing Cost W/PGR	$46,988	$85,331
Savings ($)	15,604	19,511
% Savings	24.9	18.6

TABLE 5

SUMMARY OF EXPECTED MOWING AND PGR TREATMENT COSTS FOR VARIOUS SELECTED AREAS AT NAVAL AIR STATION CECIL FIELD AND NAS JACKSONVILLE

	NAS Cecil Field	NAS Jacksonville
Total Mowing Cost W/O PGR	$107,390	$167,434
Total Mowing Cost W/PGR	$ 92,038	$132,319
Savings ($)	15,352	35,115
% Savings	14	21

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